Appendix F: Supporting Documentation for Chapter V.

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Using Appendix F

The purpose of this appendix is to provide the detailed methods and supporting documentation that are the underpinnings of the main body of the report but too detailed or extensive to report there. This appendix provides background to the information contained in Chapter V of the main body of the report. Information is included in this appendix only if the authors believed that details needed to be documented.

Project Area Wetland, Floodplain, and Riparian Impact Assessment

Purpose

Estimating the potential impacts of different project scenarios on regulated natural resources prior to project planning and design serves three purposes:

1) It helps planners gain an understanding of the magnitude of potential natural resource impacts.
2) It identifies potential areas of risk to project delivery.
3) It provides some understanding of the type and magnitude of potential mitigation need, prior to avoidance and minimization procedures.

Methods

Project impact assessment consists of:

1) identifying project scenarios for assessment;
2) establishing a project development footprint for each project scenario; and
3) estimating potential wetland, floodplain, and riparian impacts under each project development scenario.

Detailed methods follow Gersib et al. (2004)

Development Scenarios

The SR167 corridor office requested that impact assessment focus on two general project development scenarios.

- Scenario 1 assumes that one north-bound lane and one south-bound lane will be added to the entire SR-167 corridor.
- Scenario 2 assumes that two north-bound lanes and two south-bound lanes will be added to the existing SR-167 corridor.

Guided by the corridor office, we further assumed that new lanes would go in the median, when possible, before new road surface would be added to the outside of existing north- and south-bound lanes.

Subdivision of Corridor into Project Segments

We divided the project area into nine highway segments, based on the existing SR-167 Bottleneck Improvement Projects (Figure F-1, SR-167 Bottleneck Improvement Projects) provided by SR-167 planning staff. Based on the three existing bottleneck improvement projects and one division to represent the boundary between WSDOT administrative regions, nine project segments were identified and established for the SR-167 corridor (Figure F-2. SR 167 Project Segments 1 to 9).

Estimating the General Location of New Lanes by Project Segment

Using 2002 USGS digital-orthophotos, the existing pavement was outlined in the 167-project area, with approximately one-meter resolution. From a line drawn down the middle of the highway, we created three buffers for three separate circumstances,

which ultimately reflected the highway's proposed project scenarios of the addition of one or two lanes, plus a four-foot buffer in each direction. We did not include on/off ramps in the existing pavement estimates.

One data gap existed in the available USGS digital orthophotos that included approximately one mile of the SR-167 corridor north of Auburn, Washington, near Emerald Downs. One 2002 stereo-paired color aerial photograph was scanned and georeferenced to fit existing digital-orthophotos and fill this data gap.

Data Sources

To examine wetland resources we used the database of all existing and potential wetlands created in this study. The riparian forest cover was also created during the course of this study, based interpretation of the same digital-orthophotos. The floodplain coverage was taken from FEMA flood mapping for King and Pierce Counties.

Figure F-1: SR-167 Bottleneck Improvement Projects.

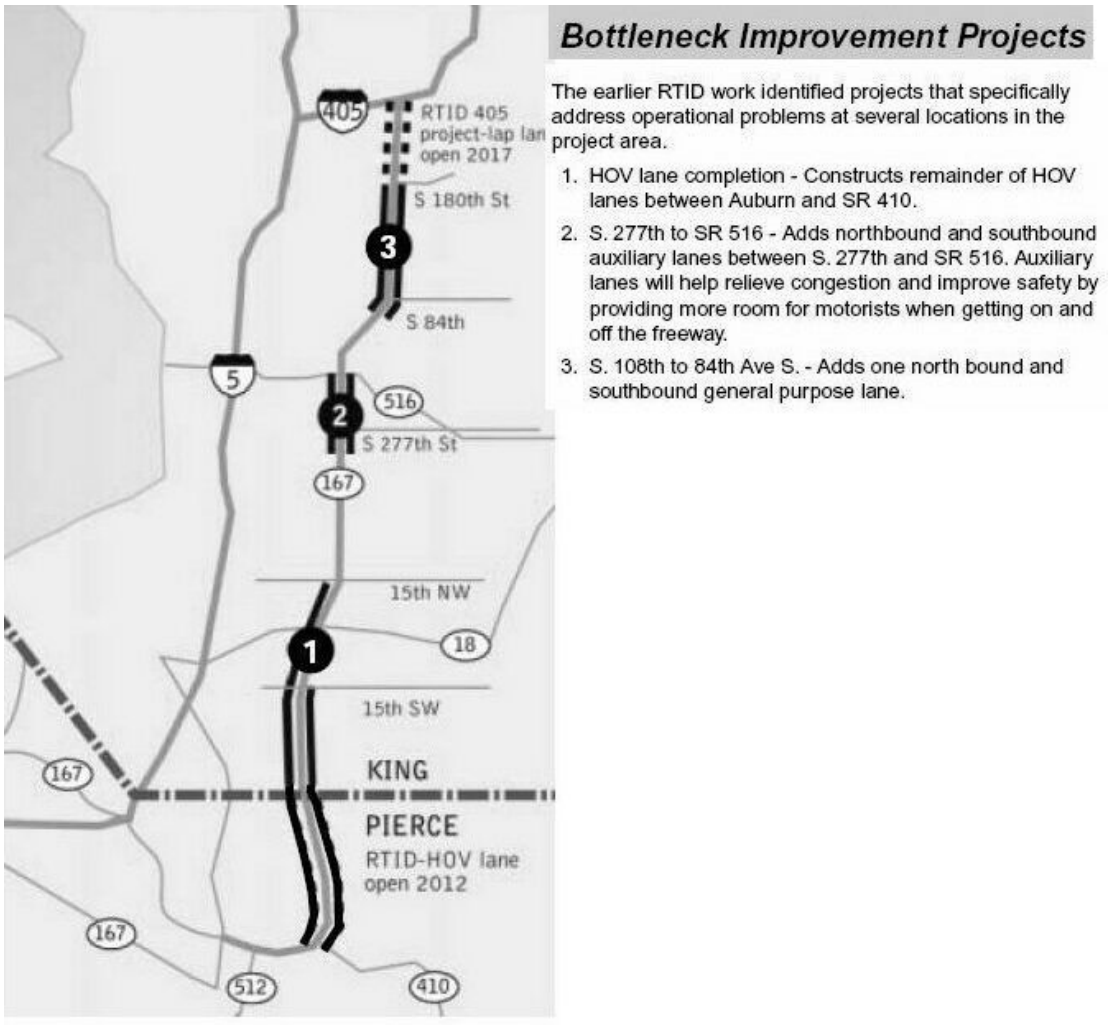
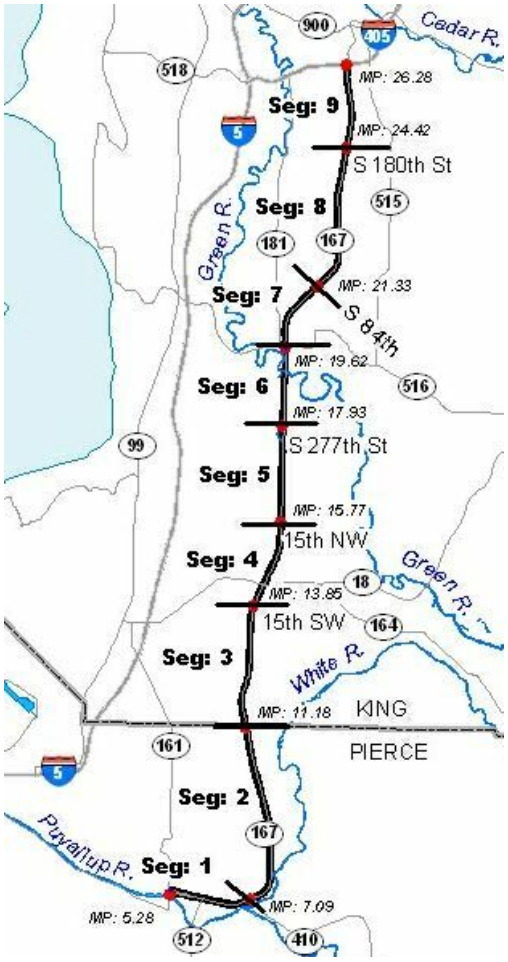


Figure F-2. SR 167 Project Segments 1 to 9.



Source, Hunter, 2005.

Data Modifications

One large FEMA floodplain polygon, in project segment 2, crossed the existing pavement of the highway and is assumed to be an error in FEMA floodplain mapping, based on field observations. To correct this assumed error, the floodplain designation was removed from the raised bed of fill associated with highway lanes and median in this project segment.

Estimation of Potential Project Impacts

Proposed project scenarios were overlaid on the wetland, riparian, and FEMA floodplain data sets. The area to wetlands, riparian areas, and FEMA floodplains were totaled within each project scenario. Potential impacts were then subdivided by highway segment.

Data Limitations

The following sources of error affect our ability to estimate potential natural resource impacts to different project scenarios. The geo-referencing process used to fill the orthophoto data gap introduces new sources of possible error, including the quality of the photo, and whether it was taken at the same angle or level of precision as the digi-

tal-orthophotos, so the interpretation of results from this segment of highway should be taken with care. The level of detail and precision in this analysis is a three-ft/1-meter level of confidence in any direction of any line.

The location and extent of wetlands within the project area are estimates used for planning purposes. No attempt was made to delineate jurisdictional wetland boundaries needed to accurately quantity potential wetland impacts. Wetland resources within the potential wetland restoration site dataset represent both current wetlands and past wetland areas having restoration potential, but that may not be jurisdictional wetlands under current conditions. Delineation of wetland resources using this dataset will likely overestimate the actual number of wetlands for each project scenario.

Results

Estimated Natural Resource Impacts, Project Development Scenario 1

The first scenario is to add one 12-foot lane and a four-foot buffer to each direction of highway. The southern portion of the highway corridor, including highway segments 1-4, currently contain two lanes in each direction, so the addition of one lane would create a highway 124 feet wide. Under this scenario, much of this additional hard surface can be placed in the grass median of the highway. The northern portion of the corridor, consisting of highway segments 5-9, currently contains three lanes in each direction, so the addition of one lane would create a highway 148 feet wide. See Table F-1 for the Scenario 1 calculations. With little or no median remaining in these highway segments, additional hard surface would have to be added to the outside of existing lanes.

Table F-1: Scenario 1 for project development

One new lane in each direction.

	South (Segments 1 – 4)		**North (Segments 5 – 9)**	
	Number	**Feet**	**Number**	**Feet**
Existing 12-foot lanes	4	48	6	72
New 12-foot lanes	2	24	2	24
10-foot shoulders	4	40	4	40
Four-foot barriers	3	12	3	12
Total		**124**		**148**

We estimate that prior to avoidance and minimization efforts, Scenario 1 will impact 59 acres of wetlands, three acres of forested riparian areas, and seven acres of FEMA floodplain throughout the SR-167 project area. Potential impact totals for Scenario 1, by highway segment, are summarized in Table 1 in the main body of this document.

Wetland resources impacted by Scenario 1 are primarily slivers along the outside of the project area. The one exception is in highway segments 1 and 3 where “road

ditch" wetlands in the median account for 33 acres, or half the impacted wetland area. Scenario 1 would also impact roughly three acres of riparian forest. These forests are linked to larger riparian systems and only occur in segments 6, 8, and 9. There are approximately seven acres of floodplain in the development footprint of Scenario 1. Most of the floodplain acreage consists of slivers along the border of the existing pavement. In total, approximately 69 acres of wetland, riparian, and floodplain resources are potentially affected by Scenario 1.

Estimated Natural Resource Impacts, Project Development Scenario 2

Scenario 2 is to increase the highway by two additional 12-foot lanes in each direction, including a 4-foot buffer for each side. The southern portion of the corridor, segments 1-4, currently contain two lanes in each direction. The addition of two lanes would create a highway 148 feet wide. If construction were concentrated in the highway median, there would be minimal hard surface needed outside of the existing pavement on the southern portion of the project. The northern portion of the corridor, segments 5-9, currently contain three lanes in each direction. The addition of two lanes would create a highway 172 feet wide. See Table F-2 for the Scenario 2 calculations. Within these highway segments, a predominance of new hard surface must go outside the existing pavement, as the current north- and south-bound lanes adjoin, separated by a Jersey barrier.

Table F-2: Scenario 2 for project development

Two new lanes in each direction.

	South (Segments 1 – 4)		North (Segments 5 – 9)	
	Number	**Feet**	**Number**	**Feet**
Existing 12-foot lanes	4	48	6	72
New 12-foot lanes	4	48	4	48
10-foot shoulders	4	40	4	40
Four-foot barriers	3	12	3	12
Total		**148**		**172**

We estimate that prior to avoidance and minimization efforts, Scenario 2 will impact 146 acres of wetlands, nine acres of forested riparian areas, and 19 acres of FEMA floodplain throughout the SR-167 project area. Potential impact totals for Scenario 2, by highway segment, are summarized in are summarized in Table 2 in the main body of this document. In total, approximately 174 acres of wetland, riparian, and floodplain resources are potentially affected by Scenario 2.

Potential Natural Resource Impacts by Highway Segment

Potential natural resource impacts throughout the SR-167 corridor were further subdivided by highway segment.

- Segment 1 includes SR 167 from the stoplight at the intersection with SR 161 to the overpass/interchange with SR 410, or approximately milepost 5.28 to milepost 7.09. The highway is split, with a grassy swale between north- and south-bound lanes. Each direction currently contains two lanes with shoulders. Results indicate that natural resource impacts within this highway segment will be limited to approximately 21 acres of wetland impacts in Scenario 1 and 25 acres of wetland impacts in Scenario 2.
- Segment 2 continues north from the SR 410 interchange to the King/Pierce County boundary, or milepost 7.09 to approximately milepost 11.18. The highway is still split, with a grass swale between north- and south-bound lanes, two in each direction with the appropriate shoulder. Results indicate that no natural resources impacts are expected for either Scenario 1 or Scenario 2.
- Segment 3 runs from the King/Pierce County boundary at milepost 11.18 to 15th SW in Auburn, milepost 13.85. The north- and south-bound lanes come together in the middle of this segment, separated by a jersey barrier, but there are still only two lanes in each direction, with the appropriate shoulder. Results indicate that natural resource impacts within this highway segment will be limited to approximately 8 acres of wetland impacts for both Scenario 1 and Scenario 2.
- Segment 4 resumes from milepost 13.85 at 15th SW to 15th NW at milepost 15.77 in Auburn. Here, the north- and south-bound lanes are split again, separated by a grassy swale, with two lanes in each direction. Results indicate that no natural resources impacts are expected for Scenario 1 and less than one acre of floodplain impacts is expected for Scenario 2.
- Segment 5 includes SR 167 from 15th NW at milepost 15.77 to milepost 17.93 at S 277th St in Kent. Both directions of highway include an additional lane used for HOV access, making three lanes in each direction, separated by a grassy divide. Results indicate that approximately six acres of wetland impacts and 2 acres of floodplain impacts are expected under Scenario 1. Under Scenario 2, impacts are expected to increase to nearly 20 acres of wetland impacts and five acres of floodplain impacts.
- Segment 6 runs from S 277th St at milepost 17.93 to the interchange with SR 516, in Kent, at milepost 19.62. The north- and south-bound lanes each include three lanes, separated by a jersey barrier. Results indicate that approximately four acres of wetland impacts, less than half acre of riparian impacts, and four acres of floodplain impacts are expected under Scenario 1. Under Scenario 2, impacts are expected to increase to 14 acres of wetland impacts, one half acre of riparian impacts, and nearly 12 acres of floodplain impacts.
- Segment 7 continues from the SR 516 interchange at milepost 19.62 to S 84th, in Kent, at milepost 21.33. The north- and south-bound lanes each include three lanes, separated by a jersey barrier. Results indicate that approximately one acre of wetland impacts and less than half an acre of floodplain impacts are expected under Scenario 1. Under Scenario 2, impacts are expected to in-

crease to nine acres of wetland impacts and still less than half an acre of floodplain impacts.

- Segment 8 resumes from S 84th, in Kent, at milepost 21.33 to milepost 24.42 at S 180th in Renton. The north- and south-bound lanes each include three lanes, separated by a jersey barrier. Results indicate that approximately six acres of wetland impacts, two acres of riparian impacts, and approximately one half acre of floodplain impacts are expected under Scenario 1. Under Scenario 2, impacts are expected to increase to nearly 27 acres of wetland impacts, 6 acres of riparian impacts, and nearly two acres of floodplain impacts.
- Segment 9 begins at milepost 24.42 at S 180th, and ends at the interchange with I 405 at milepost 26.28. The highway here is still three lanes in each direction, but also contains long interchanging off-ramps. Results indicate that approximately 13 acres of wetland impacts, over one acre of riparian impacts, and less than half an acre of floodplain impacts are expected under Scenario 1. Under Scenario 2, impacts are expected to increase to nearly 43 acres of wetland impacts, nearly three acres of riparian impacts, and still less than one half acre of floodplain impacts.

Results by segment may be found in Chapter V of the main body of this document.

Project Area Stormwater Runoff Impacts

The existing highway in the project segments has about 237 acres of pavement and 47 acres of landscaping. One new lane in each direction will add 89 acres of impervious area. Two new lanes in each direction will add 147 acres of impervious area. Virtually all of the new project areas will cover modified soils that were historically placed as fill within the Green, White, and Puyallup river valleys.

These new impervious surfaces will increase stormwater runoff volumes and peak flows in the Mid Puyallup River, Lower White River, Mill Creek, and Black River subbasins. Runoff from MP 6.16 to MP 7.10 flows into the Puyallup River. The Highway Runoff Manual (HRM) exempts areas that discharge directly to this reach of the Puyallup from stormwater flow control requirements (WSDOT, 2004). From MP 7.10 to 13.64 project runoff flows into an unnamed drainage channel that parallels the highway and enters the Lower White River just upstream from its confluence with the Puyallup River. From MP 13.64 to 19.05 the highway drains directly into Mill Creek. From MP 19.05 to 26.28 the highway discharges into ditches and tributaries of Springbrook Creek and the Black River.

We used WSDOT's MGS Flood model to develop planning-level estimates of project stormwater storage needs. The model simulates runoff from the project area, and estimates how much storage will be needed to meet flow control requirements specified in the HRM (WSDOT, 2004). These flow control requirements are designed to mitigate stormwater impacts to peak flows and stream channel erosion.

Because the entire project area has similar soil and precipitation characteristics, we used the model to estimate the unit area storage values shown in Table F-3.

Table F-3. Estimated unit area storage values.

Post-project land cover	Unit storage, pre-developed scenario (acre-ft/acre)	
	Forest	Grass
Grass on alluvial or till soils	0.18	0.00
Impervious on alluvial or till soils	0.75	0.34

These volumes represent total pond storage, including freeboard. We assumed the modified fill soils that underlie the project have runoff characteristics similar to glacial till, following HRM guidelines for compacted alluvial soils. We quantified stormwater impacts by multiplying the unit storage values by the project area in each highway segment.

Table F-4 summarizes the storage volumes needed for the two project alternatives, assuming full retrofit of the existing highway lanes. Storage estimates are presented for both grass and forest pre-developed land cover scenarios. Grass is used to represent the landscaped fill material that makes up the existing land cover in most of the project area. The HRM recommends using the existing land cover as the pre-developed condition for projects in urban catchments. Forest represents the pre-European settlement land cover in much of the project area, and is the default pre-developed land cover scenario used in Ecology's Stormwater Manual for Western Washington.

Table F-4. Net detention storage volumes, acre-feet.

Scenario 1			
Segment	**Forest**	**Grass**	**75 Percent Forest, 25 Percent Grass**
1	11.91	4.74	8.22
2	41.38	18.55	28.37
3	30.95	13.89	21.22
4	21.82	9.79	14.96
5	26.26	11.78	18.00
6	29.12	13.07	19.96
7	22.34	10.02	15.31
8	39.50	17.72	27.08
9	23.31	10.46	15.98
Scenario 1, totals	**246.59**	**110.02**	**169.11**
Scenario 2			
1	13.45	5.64	9.26
2	50.32	22.57	34.50

3	34.75	15.59	23.82
4	26.77	12.01	18.35
5	30.99	13.90	21.24
6	34.07	15.28	23.36
7	26.08	11.70	17.88
8	46.26	20.75	31.71
9	27.37	12.28	18.77
Scenario 2, totals	**290.06**	**129.74**	**198.89**

The detention volume that is needed (with appropriate discharge orifice sizing) to match predevelopment flow/duration functions.

These storage estimates assume traditional stormwater detention is the only method used to mitigate stormwater flow impacts. Infiltration and Low Impact Development methods could be used to reduce these storage needs, where topography and soil conditions are appropriate.

Project Impacts to Anadromous Fish

To be added.

References for Appendix F

Hunter, Carol. 2005. 167 Project Corridor Plan. Washington State Department of Transportation, Urban Corridors Office.

Washington State Department of Transportation. 2004. Highway Runoff Manual. Washington State Department of Transportation. Publication #M 31-16